Growing Solution-Based and High-Temperature Crystals

Improved growth methods lead to significant advances in laser and nonlinear crystals

LLNL has an extensive program for growing both high-temperature and solution-based crystals. We also model crystal growth, and we can characterize crystals via x-ray and electron microscopy, atomic force microscopy, phase interferometry, polarimetry, photometry, and thermomechanical and thermochemical properties.

High-temperature crystals up to 10 cm in diameter

At LLNL, we have capabilities to synthesize and refine high-temperature crystals. We can grow such crystals up to 10 cm in diameter using the Czochralski or Bridgman process. We have grown and characterized many novel laser crystals, including large, high-quality oxide and fluoride crystals, such as Cr:$LiSrAlF_6$ and Ce:$LiSrAlF_6$. Our high-temperature furnaces can accommodate melting points up to 2000°C and neutral atmosphere or vacuum environments.

APPLICATIONS

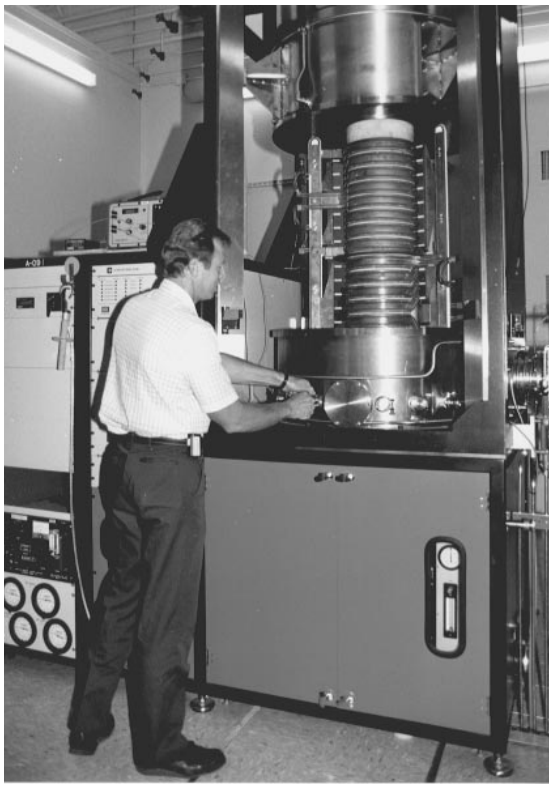
- *Laser crystals (e.g., Cr:LiSAF and Ce:LiSAF)*
- *Nonlinear optical crystals (e.g., KDP, ADP, and LAP)*
- *Infrared detection crystals (e.g., nickel sulfate)*
- *Organic crystals (e.g., adenine phosphate)*
- *Application to other crystal systems*

Solution-based crystals up to 15 cm on a side

With recent advances, we can grow boules that yield an exceptionally large number of high-quality plates up to 15 cm on a side. We have grown a number of crystals from water-, ammonia-, and alcohol-based solutions. These include

- Nonlinear optical crystals, such as potassium dihydrogen phosphate (KDP), ammonium dihydrogen phosphate (ADP), and L-argenine phosphate (LAP)
- Infrared detection crystals, such as nickel sulfate
- Organic crystals such as adenine phosphate.

We are able to grow crystals with a small seed, which reduces dislocation density and internal strain and increases yield. Our method is based on general principles, which should allow us to apply it to other crystal systems.



High-temperature Bridgman furnace capable of growing crystals up to 100 mm in diameter and 200 mm in length with melting points up to 2000°C.

Availability: Our facilities are fully operational. We seek industrial partners with whom we can cooperatively develop processes to produce melt or solution- and flux-based crystals, both organic and inorganic.

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